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CEMENT AND LIME MANUFACTURE

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JULY, 1949

Comparison of the Portland Cement Specifications of the World.*

ON pages 64 to 73 are continued the tables giving the requirements of the standard specifications for Portland cement of most countries of the world. The tables of chemical composition, setting time, soundness, and strength in pounds per square inch are given in this journal for May last. In the present number the tables give the strength in kilogrammes per square centimetre, the fineness, and the method of preparing specimens for the strength tests. The following notes supplement the data given in the tables.

AUSTRIA.—The standards adopted are as those of Germany.

HUNGARY.—The standard specifications of 1935 for ordinary and rapid-hardening Portland cement require the molecular ratio $\frac{C}{S + A + F + Mn}$ to be not less than 1.8, and the maximum amounts of the constituents are: MgO, 5 per cent.; SO₃, 3 per cent.; insoluble residue, 2 per cent.; and loss on ignition, 5 per cent. The specific gravity must exceed 3. The initial setting-time must be not less than one hour and the final setting-time not less than three hours or more than twelve hours. The hot-pat test is accepted as a provisional test, but the results of the cold-pat test are decisive. The minimum tensile strengths in lb. per square inch (kilogrammes per square centimetre in brackets) are: 213 (15) at seven days and 313 (22) at 28 days for ordinary Portland cement; 284 (20) at two days, 384 (27) at seven days, and 427 (30) at 28 days for high-strength rapid-hardening Portland cement. The minimum compressive strengths are 2844 (200) at seven days and 3982 (280) at 28 days for ordinary Portland cement; 3555 (250) at two days, 5688 (400) at seven days, and 7110 (500) at 28 days for high-strength rapid-hardening Portland cement. No bending test is specified. The fineness is the same for both types of cement, and the maximum

* Concluded from May, 1949.

residue is 2 per cent. on a sieve with 900 meshes per square centimetre (diameter of wire 0.13 mm.) and 20 per cent. with 4900 meshes (diameter of wire 0.055 mm.). The sand used for the specimens for the strength tests is Berlin "normal" sand, and the water-cement ratio is 0.3. The tensile-test specimens are prepared by the method marked K1 in Table V, and the compressive-test specimens, which have a loaded area of 50 sq. cm., by method K4.

LUXEMBOURG.—The Belgian standards are adopted.

NEW ZEALAND.—The British standards are adopted.

ROUMANIA.—New standards were published in 1948 and requirements different from those given in the tables include the omission of the specific gravity and the limiting ratios of chemical constituents. The insoluble residue must be not more than 5 per cent. for ordinary Portland cement and 1 per cent. for rapid-hardening and high-strength Portland cement. The loss on ignition must be not more than 4 per cent. Permitted additions must not exceed 1 per cent. although ordinary cement may contain substances with hydraulic properties (such as trass, pozzolana, and burnt clay) if the permitted amount of insoluble residue is not exceeded. The final setting time must not exceed ten hours. The cold-pat test is excluded and the hot-pat test includes boiling for two hours. Tensile strengths in lb. per square inch (kilogrammes per square centimetre in brackets) are 284 (20) at seven days and 398 (28) at 28 days for ordinary Portland cement; 356 (25) at three days, 384 (27) at seven days, and 425 (30) at 28 days for rapid-hardening Portland cement; 384 (27) at three days, 427 (30) at seven days, and 498 (35) at 28 days for high-strength Portland cement. The compressive strengths are 2844 (200) at seven days and 4266 (300) at 28 days for ordinary Portland cement; 3555 (250) at three days, 4266 (300) at seven days, and 5688 (400) at 28 days for rapid-hardening Portland cement; 4266 (300) at three days, 5688 (400) at seven days, and 7110 (500) at 28 days for high-strength Portland cement. The fineness for all types of cement is a residue not exceeding 15 per cent. on a sieve having 4900 meshes per square centimetre. The water-cement ratio of specimens for the strength tests is 0.32.

SAUDI-ARABIA.—Provisional standards for ordinary Portland cement published in 1948 contain the following requirements: $\frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3}$ not less than 0.7 and not greater than 2; the specific gravity not less than 3 and not greater than 3.25. The maximum amounts of constituents are MgO, 5 per cent.; SO₃, 2 per cent.; insoluble residue, 0.75 per cent.; loss on ignition, 3 per cent.; Al₂O₃, 6 per cent.; Fe₂O₃, 6 per cent.; 3CaO.SiO₂, 50 per cent.; 3CaO.Al₂O₃, 8 per cent.; the minimum amount of SiO₂ is 21 per cent. The fineness is determined by a turbidimeter and must be not less than 1600 sq. cm. per gramme. The initial setting-time must be not less than 45 minutes and the final setting-time not more than ten hours. Expansion in the autoclave must not exceed 0.5 per cent. The tensile strengths in lb. per square inch (kilogrammes per square centimetre in brackets) are 125 (8.8) at three days, 250 (17.6) at seven days, and 350 (24.6) at 28 days. The compressive strengths are 750 (53) at three days, 1500 (105)

at seven days, and 3000 (211) at 28 days. The compressive strength test is made on specimens of 1 cement : 2.75 sand.

SPAIN.—The latest standards for Spain were published in 1936 and the requirements are very similar to those of the 1930 edition. The following supersede or supplement the data given in the tables. In addition to the molecular ratio

indicated, $\frac{\text{SiO}_2}{\text{Al}_2\text{O}_3}$ must not be less than 2.5. The total S must not exceed

1.25 per cent.; $\text{MgO} + \text{SO}_3$ must not exceed 6.5 per cent. The insoluble residue must be less than 1.5 per cent. In ordinary Portland cement the permitted amounts of added materials are gypsum 3 per cent. and water 2 per cent.; in rapid-hardening Portland cement the maximum permitted addition including gypsum is 6 per cent. The soundness tests comprise the hot-pat test (half-an-hour plus 2½ hours), and the cold-pat test; the decisive test is the moist storage of pats for 28 days. The sand for the strength-test specimens is from Manzanares and is graded from 1 mm. to 1.5 mm., the mixture, of normal consistency, being 600 g. of cement to 1 litre of sand. The compressive test is on 70-mm. cubes. The tensile strengths of rapid-hardening Portland cement in lb. per square inch (kilogrammes per square centimetre in brackets) are 356 (25) at three days, 427 (30) at seven days, and 540 (38) at 28 days; the compressive strengths are 3555 (250) at three days, 4977 (350) at seven days, and 6399 (450) at 28 days; different compressive strengths are required for 8-in. (20-cm.) cubes.

UNITED STATES.—The data given in the tables relate to the standards published in 1947 by the American Society for Testing Materials (C150-47). The Federal Specification No. SS-C-192 of 1946 conforms to the A.S.T.M. standards except in the following particulars. In low-heat cement (LH) the maximum amount of SO_3 is 2.25 per cent., and the loss on ignition is 2.5 per cent. For all types of cements the A.S.T.M. standards limit the permitted additions to 1 per cent. of materials the composition and quantity of which are subject to approval. The Federal specifications permit the addition of less than 1 per cent. as a grinding aid. No limiting proportions of compounds are specified for ordinary Portland cement in the A.S.T.M. standards, but the Federal specification stipulates the maximum amounts as Al_2O_3 , 7.5 per cent.; Fe_2O_3 , 6 per cent.; and $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, 15 per cent. These amounts also apply to rapid-hardening Portland cement, for which the A.S.T.M. standard restricts the amount of C_3A only. In addition to the compounds in low-heat cement and high-sulphate-resistant cements, the amounts of which are restricted in the A.S.T.M. standards, the Federal specifications limit SiO_2 to 22 per cent. (minimum) and Al_2O_3 to 6 per cent. (maximum) in low-heat cement, and SiO_2 to 23 per cent. (minimum) in high-sulphate-resistant cement, and also allow for a low-alkali cement in which the quantity of alkali must not exceed 0.60 ($\text{NaO} + 0.658\text{K}_2\text{O}$). The Federal specifications accept the fineness as measured by a Blaine fineness-meter or by a Wagner turbidimeter. The minimum specific surfaces required when the latter apparatus is used conform to those in the A.S.T.M. standards except for moderate-sulphate-resistant low-heat

(Continued on page 74)

TABLE IIIA.—STRENGTH OF PORTLAND CEMENT (KILOGRAMS PER SQUARE CENTIMETRE).

NOTES.—For dates of Standards see Table I.

(1) The following countries, which adopt the standards of other countries, are omitted: Egypt (O., as Britain, 1947); Iceland (O., as Denmark, 1933); India (O., as Britain, 1947); Jamaica (O., as Britain, 1947); Paraguay (as Argentina); Peru (as United States); South Africa (O. and R.H., as Britain, 1947).

(2) Abbreviations of types of cement: H.S., high strength; L.H., low heat; L.S., low strength; M.L.H., moderate low heat; M.S.R., moderate sulphate resistant; O., ordinary; R.H., rapid-hardening; S.R., sulphate resistant.

(3) Strengths are measured on 3 sand : 1 cement mortar except where indicated otherwise. Tests marked * are optional. c.s. = combined wet and dry storage.

Country (See Note 1)	Type of Cement (See Note 2)	Tensile Strength Age of specimen in days						Bending Strength Age of specimen in days				Compressive Strength Age of specimen in days					
		Age of specimen in days						Age of specimen in days				Age of specimen in days					
		1	2	3	7	28	28 (c.s.)	1	3	7	28	1	2	3	7	28	28 (c.s.)
Argentina	O.	—	—	—	20	28	—	—	—	—	—	—	—	—	230	325	—
	R.H.	20	25	30	35	—	50	—	—	—	—	225	350	400	450	—	600
Australia	O.	—	—	—	—	—	—	—	—	—	—	—	—	176	246	316	—
	R.H.	—	—	—	—	—	—	—	—	—	—	—	—	281	387	457	—
Belgium	O.	—	—	18	23	27	—	—	—	—	—	—	—	200	300	400	—
	H.S.	—	—	23	27	30	—	—	—	—	—	—	—	300	400	500	—
	R.H.	20	—	27	30	—	—	—	—	—	—	225	—	400	500	—	—
Brazil	O.	—	—	—	—	—	—	—	—	—	—	—	—	80	150	250	—
	R.H.	—	—	—	—	—	—	—	—	—	—	110	—	220	310	—	—
Britain	O.	—	—	21.09	26.37	—	—	—	—	—	—	—	—	112.5	175.8	—	—
	R.H.	21.1	—	31.63	—	—	—	—	—	—	—	112.5	—	246.1	—	—	—
	L.H.	—	—	—	—	—	—	—	—	—	—	—	—	70.3	112.5	263.65	—
Bulgaria	O.	—	—	—	18	25	30	—	—	—	—	—	—	—	200	300	400
	R.H.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	500
Canada	O.	—	—	25	—	30	40	—	—	—	—	—	—	—	—	—	—
	R.H.	—	—	14.1	19.3	24.6	—	—	—	—	—	—	—	—	—	—	—
	O.	19.3	—	26.4	—	—	—	—	—	—	—	—	—	—	—	—	—
	R.H.	—	—	10.5	17.6	24.6	—	—	—	—	—	—	—	—	—	—	—
Chile	S.R.	—	—	—	25	30	—	—	—	—	—	—	—	—	—	—	—
	O.	—	—	—	25	30	—	—	—	—	—	—	—	—	250	350	—
	H.S.	—	—	25	30	38	—	—	—	—	—	—	—	250	350	450	—
China	O.	—	—	—	18	25	—	—	—	—	—	—	—	—	180	275	—
	H.S.	—	—	25	30	30	—	—	—	—	—	—	—	250	—	400	—
	O.	—	—	—	18	25	30	—	—	—	—	—	—	—	200	275	350
Czechoslovakia	R.H.	—	—	25	28	30	40	—	—	—	—	—	—	275	375	425	500

[illegible]

† 2 : 1 mortar. ‡ 2·77 : 1 mortar.

TABLE IIIA.—STRENGTH OF PORTLAND CEMENT (KILOGRAMS PER SQUARE CENTIMETRE). (Cont.)

NOTES.—For dates of Standards see Table I.

(1) The following countries, which adopt the standards of other countries, are omitted: Egypt (O., as Britain, 1947); Iceland (O., as Denmark, 1933); India (O., as Britain, 1947); Jamaica (O., as Britain, 1947); Paraguay (as Argentina); Peru (as United States); South Africa (O. and R.H., as Britain, 1947).

(2) Abbreviations of types of cement: H.S., high strength; L.H., low heat; L.S., low strength; M.L.H., moderate low heat; M.S.R., moderate sulphate resistant; O., ordinary; R.H., rapid hardening; S.R., sulphate resistant.

(3) Strengths are measured on 3 sand : 1 cement mortar except where indicated otherwise. Tests marked * are optional. c.s. = combined wet and dry storage.

Country (See Note 1)	Type of Cement (See Note 2)	Tensile Strength Age of specimen in days					Bending Strength Age of specimen in days					Compressive Strength Age of specimen in days				
		1	2	3	7	28	28(c.s.)	1	3	7	28	1	2	3	7	28
Sweden	O. R.H. L.H.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
								30*	60	45	65	150*	—	325	400*	500
								—	—	30*	50	—	—	—	150*	275
Switzerland	O. H.S.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
								—	—	35	45	—	—	—	180	275
Turkey	O. R.H.	—	—	—	22	27	32	—	40	50	60	—	—	250	340	420
								—	—	—	—	—	—	—	300	350
U.S.A.**	O. M.S.R.-M.L.H.	—	—	—	10.5	19.3	24.6	—	—	—	—	—	—	350	—	425
					8.8	17.6	22.8	—	—	—	—	—	—	63	127	211
					26.4	—	—	—	—	—	—	—	—	53	105	211
	R.H. L.H.	19.3	—	—	12.3	21.1	—	—	—	—	—	88	—	176	—	—
	S.R.	—	—	—	12.3	21.1	—	—	—	—	—	—	—	—	56	141
Uruguay	O. R.H.	—	—	—	—	—	—	—	—	—	—	—	—	—	70	155
								—	—	—	—	—	—	—	150	—
Venezuela	O. O.	—	—	—	20	25	—	—	—	—	—	110	—	—	316	—
Yugo-Slavia	O. H.S.	—	—	—	16	—	—	—	—	—	—	—	—	—	—	—
		20	—	—	28	—	—	—	—	—	—	—	—	—	200	280
								—	—	—	—	—	—	—	400	—

** 2.75 : 1 mortar.

TABLE IV.—FINENESS OF PORTLAND CEMENT.

NOTES.

(1) The following countries, which adopt the standards of other countries, are omitted: Egypt (O., as Britain, 1947); Iceland (O., as Denmark, 1933); India (O., as Britain, 1947); Jamaica (O., as Britain, 1947); Paraguay (as Argentina); Peru (as United States); South Africa (O. and R.H., as Britain, 1947).

The standards for the following countries, which are omitted, contain no requirements for fineness: Australia, Finland, France, Sweden, Uruguay.

(2) Abbreviations: H.S., high strength; L.H., low heat; L.S., low-strength; M.L.H., moderate low heat; M.S.R., moderate sulphate resistant; O., ordinary; R.H., rapid hardening; S.R., sulphate resistant.

(3) Sieve references given as 900 and 4900 are the number of apertures per square centimetre; references given as 170 and 200 are the number of apertures per linear inch.

Country and date of Standard (See also Note 1)	Type of cement (See Note 2)	Sieve Analysis				Specific Surface	
		Sieves (See Note 3)	Aperture (mm.)	Diameter of wire (mm.)	Maximum residue (per cent.)	Minimum (sq. cm. per gr.)	Apparatus
Argentina (1947)	O.	900	—	0.15	1	—	—
	R.H.	4900	—	0.05	15	—	—
	O.	4900	—	0.05	10	—	—
Belgium (1941)	H.S.	4900	0.090	—	18	—	—
	R.H.	4900	0.090	—	14	—	—
		4900	0.090	—	10	—	—
Brazil (O.—1937, R.H.—1940)	O.	—	0.075	0.053	15	—	—
	R.H.	—	0.075*	0.053	6	—	—
Britain (1947)	O.	170	0.089	—	10	2250	Air-permeability
	R.H.	170	0.089	—	5	3250	"
	L.H.	—	—	—	2	3200	"
	O.	900	—	—	25	—	—
Bulgaria (1941)	R.H.	4900	—	—	—	—	—
	O.	200	0.074	—	18	—	—
Canada (O., R.H.—1940, S.R.—1942)	R.H.	—	—	—	—	—	—
	S.R.	200	0.074	—	18	—	—
Chile (1941)	O. and H.S.	900	—	0.130	1.5	—	—
		4900	—	0.055	16	—	—
China (1934)	O.	900	—	0.100	1	—	—
		4900	—	0.050	10	—	—

Country	Year	Wavelength (mμ)	Concentration (g/100 ml)	Optical Density	Scattering Coefficient (cm ² /g)	Turbidimeter
Palestine	(1947)	O.	170	0.089	10	
Poland	(1947)	R.H.	170	0.089	5	
		O.	900	0.200	2	
	(O.—1946)		4900	0.080	20	
	H.S.—(1948)	H.S.	900	0.200	1	
			4900	0.080	10	
Portugal		L.S.	900	0.150	2	
	(L.S. O.—1930.		4900	0.050	25	
	L.H.—1946.	O.	900	0.150	2	
	S.R.—1932)		4900	0.050	5	
		L.H.	—	—	—	1800
		S.R.	—	—	—	Turbidimeter
Roumania		O.	900	0.088	1	
	(1934)		4900	0.055	20	
		H.S.	900	0.088	1	
			4900	0.055	20	
		R.H.	900	0.088	1	
			4900	0.055	20	
		O.	900	0.233	2	
			4900	0.093	25	
		R.H.	900	0.233	1	
			4900	0.093	15	
		O.	900	0.100	1	
			4900	0.050	16	
		R.H.	900	0.100	0.5	
			4900	0.050	6	
		O.	4900	0.055	10	
		H.S.	4900	0.055	10	
		O.	900	0.055	1	
			4900	—	14	
		R.H.	900	—	1	
			4900	—	14	
		Type I (O.)	—	—	—	1500*
		Type II	—	—	—	1600*
		(M.S.R.—M.L.H.)	—	—	—	
		Type III (R.H.)	—	—	—	1700*
		Type IV (L.H.)	—	—	—	1700*
		Type V (S.R.)	—	—	—	
		O.	200	—	20	
		O. and H.S.	900	0.100	3	
			4900	0.050	25	
United States of America	(1947)		—	—	—	Turbidimeter
Venezuela	(1941)		—	—	—	"
Yugoslavia	(1931)		—	—	—	"
			—	—	—	"

* For one specimen. Average must be 100 sq. cm. greater.

TABLE V.—PREPARATION OF SPECIMENS FOR STRENGTH TESTS (PORTLAND CEMENT).

NOTES.—For dates of Standards see Tables I, II, and IV.

(1) The following countries, which adopt the standards of other countries, are omitted: Egypt (O., as Britain, 1947); Iceland (O., as Denmark, 1933); India (O., as Britain, 1947); Jamaica (O., as Britain, 1947); Paraguay (as Argentina); Peru (as United States); South Africa (O. and R.H., as Britain, 1947).

(2) Mortars 3 sand : 1 cement unless stated otherwise. V = Vicat test. N is the percentage of water required to form a paste which permits the 1-cm. diameter Vicat plunger, for most standards, to settle to 5 mm. to 7 mm. from the base, and, for the standards of Canada, United States, and Mexico, to penetrate 10 mm. in 30 seconds. F.T.1 = Mortar to spread on flow-table 60 per cent. to 100 per cent. F.T.2 = 2.75 : 1 mortar to spread on flow-table 100 per cent. to 115 per cent. (2.77 : 1 mortar for Mexico). F.T.3 = Mortar to spread on flow-table 28 per cent. to 36 per cent. E1 = To exude after 90 to 110 blows of Bohm hammer. E2 = To exude after 90 to 110 blows of Klebe hammer. E3 = To exude after 48 to 58 blows of Klebe hammer.

(3) B = 150 blows with 2-kg Bohm hammer falling 16.8 cm. H1 = Hand filled and beaten with spatula (weight about 350 g.). H2 = Hand filled in two layers each tumbled 12 times. K1 = 120 blows with 2-kg., Klebe hammer falling 25 cm. K2 = 150 blows with 3.4 kg. Klebe hammer falling 50 cm. K3 = as K2 but 3-kg. hammer. K4 = as K2 but 3.2 kg. hammer. K5 = 160 blows with 3-kg. Klebe hammer falling 50 cm. P = Broken prisms bending test.

Country (see Note 1)	Standard Sand	Consistency of Mortar (see Note 2)			Method of making specimens (see Note 3)		Remarks		
		Source	Grading (mm.) or Standard Sieves (*Meshes per sq. cm.)	Compressive tests		Tensile and bending tests		Compressive tests	
				Method	Water (per cent.)			Method	Water (per cent.)
Argentina Australia	Oriental Leighton Buzzard	1.5 to 1.0 B.S.18 to B.S.25	1.5 to 1.0 B.S.18 to B.S.25	V	$\frac{N}{6} + 4.5$	V	$\frac{N}{6} + 4.5$	K2	50
				—	—	V	0.27N to 0.30N	B	50
Belgium Brazil	Ramillies	64 to 144*	V	$\frac{N}{4}$	V	$\frac{N}{4}$	V	K3	50
	Tiete river	Equal parts of 1.2 to 2.4 0.6 to 1.2 0.3 to 0.6 0.15 to 0.3	—	—	—	$N + 2.5$ 4	—	—	2.5-cm. dia. 19.64 pestle 17 cm. long ; 5 cm dia. cylinder 10 cm. long(a)
								K1	Wire dia. 0.3 mm.
									(a) Filled in 4 layers each tamped 30 times.

TABLE V.—PREPARATION OF SPECIMENS FOR STRENGTH TESTS (PORTLAND CEMENT). (Cont.)

NOTES.—For dates of Standards, see Tables I, II, and IV.

(1) The following countries, which adopt the standards of other countries, are omitted: Egypt (O., as Britain, 1947); Iceland (O., as Denmark, 1933); India (O., as Britain, 1947); Jamaica (O., as Britain, 1947); Paraguay (as Argentina); Peru (as United States); South Africa (O. and R.H., as Britain, 1947).

(2) Mortars 3 sand: 1 cement unless stated otherwise. V = Vicat test. N is the percentage of water required to form a paste which permits the 1-cm. diameter Vicat plunger, for most standards, to settle to 5 mm. from the base, and, for the standards of Canada, United States, and Mexico, to penetrate 10 mm. in 30 seconds. F.T.1 = Mortar to spread on flow-table 60 per cent. to 100 per cent. F.T.2 = 275: 1 mortar to spread on flow-table 100 per cent. to 115 per cent. (277: 1 mortar for Mexico). F.T.3 = Mortar to spread on flow-table 28 per cent. to 36 per cent. E1 = To exude after 90 to 110 blows of Bohm hammer. E2 = To exude after 90 to 110 blows of Klebe hammer. E3 = To exude after 48 to 58 blows of Klebe hammer.

(3) B = 150 blows with 2-kg. Bohm hammer falling 16.8 cm. H1 = Hand filled and beaten with spatula (weight about 350 g.). H2 = Hand filled in two layers each thumbed 12 times. K1 = 120 blows with 2-kg. Klebe hammer falling 25 cm. K2 = 150 blows with 3.4-kg. Klebe hammer falling 50 cm. K3 = as K2 but 3-kg. hammer. K4 = as K2 but 3.2-kg. hammer. K5 = 160 blows with 3-kg. Klebe hammer falling 50 cm. P = Broken prisms from bending test.

Country (see Note 1)	Standard Sand		Consistency of Mortar (see Note 2)			Method of making specimens (see Note 3)			Remarks
	Source	Grading (mm.) or Standard *Meshes per sq. cm.	Tensile and bending tests		Compressive tests		Tensile and bending tests	Compressive tests	
			Method	Water (per cent.)	Method	Water (per cent.)			
Netherlands	Berlin	1:39 to 0.74	—	8	—	8	B	B	50
	Berlin	1:39 to 0.74	—	E1	—	E1	B	B	50
Norway	Leighton	B.S.18 to B.S.25	V	0.195N + 2.5	—	10	H1	Vibrated (b)	50
Palestine	Buzzard								
	Berlin	2 parts 1:39 to 0.74 and 1 part fine (h)	—	15	—	15	As Germany	P	25
Poland									
Portugal	Alfete	1:5 to 1.0	—	E2	—	E2	K1	K3	50
Romania	—	1:35 to 0.78	—	E1	—	E1	B	B	50
Russia	—	64 to 144*	—	E3	—	E3	K1	K3	50
Spain	—	1:5 to 1.0	—	E1	—	E1	B	B	50
Sweden	Berlin	As Poland	—	14	—	14	As Finland	P	16

Switzerland	Oberdiessbach	Coarse : 6.0 to 4.0 Medium : 4.0 to 1.0 Fine (j)	—	II	—	II	Hand-filled 4 cm. by 4 cm. by 16 cm. prism lightly tamped with 1-kg. pestle	P	16	(j) Fine : 0.750 mm. 65 to 70 per cent. 0.200 mm. 42 to 50 per cent. 0.120 mm. 33 to 40 per cent. 0.090 mm. 21 to 27 per cent. 0.060 mm. 10 to 15 per cent.
Turkey	Sultan Tchiftlik	1.39 to 0.74	V	$\frac{N}{4} + 2.5$	—	E2	B	B	50	(l) Each layer tamped 32 times with 150-g. tamper. (k) 1.190 mm., nil. 0.059 mm., 2 (± 2) per cent. 0.297 mm., 72 (± 5) per cent. 0.149 mm., 98 (± 2) per cent.
United States of America	Ottawa	For tensile test : 0.84 to 0.59 For compressive test : 1.190 to 0.149 (k)	V	$\frac{N}{6} + 6.5$	F.T.2	—	H2	Hand filled in 2 layers (l)	25.8	
Uruguay	Carasco	Equal parts : 2.380 to 1.180 1.190 to 0.597 0.590 to 0.297 0.297 to 0.149 64 to 144* 64 to 144*	—	—	F.T.3	—	—	As Brazil	19.64	
Venezuela	Berlin		—	E2	—	E2	B	—	—	
Yugoslavia	Berlin		—	E2	—	E2	Kr	K4	50	

(continued from page 63)

cement (MSR-MLH) for which the Federal limits are 1800 sq. cm. average and 1700 sq. cm. minimum. The Federal specifications do not require a tensile test.

YUGOSLAVIA.—The standards published in 1948 do not differ much from those of 1931 except that the sand used for the strength tests is a natural sand obtained in Yugoslavia and contains 98 per cent. of SiO_2 , passes a sieve with 64 meshes per square centimetre, and is retained on a sieve with 144 meshes per square centimetre. The compressive strength of high-strength cement at two days must be 3413 lb. per square inch (240 kg. per square centimetre).

For most of the foregoing additions to our own tables we are indebted to "Tabular Review of the Portland Cement Standards of the World" recently issued by the Cembureau (The Cement Statistical and Technical Bureau), of Stormsgatan 16, Malmö, Sweden (price 2.50 United States dollars). These tables give in the English language the principal requirements of the standard specifications of thirty-four countries and include ordinary, high-strength, rapid-hardening, low-heat, sulphate-resistant, and air-entraining Portland cements. Seventeen other countries, which have no national standards or accept those of other nations, are mentioned.

Revised standards were issued recently in Belgium; it is intended to review these in a later number of this journal.

Calcite Concrete.

It is claimed in Sweden that the effects of adding calcite (CaCO_3) to concrete are improvement of resistance to attack by seawater and by sulphuric acid, neutralisation of humus, and increased compressive strength. A homogeneous mixture of increased workability with less water is obtained by adding calcite, which appears to have a neutralising effect on the free lime in the cement, to the extent of 20 per cent. to 30 per cent. of the weight of cement. This note is from "Building Science Abstracts"; the original article appeared in "Betong."

A 400-ft. Rotary Kiln.

A UNAX rotary kiln 400 ft. long by 11 ft. diameter, carried on six tyres, has been put into operation at Bellingham, Washington, U.S.A., by the Olympic Portland Cement Co. A feature of the kiln is a Buell cyclone dust collector which returns the dust continuously to the feed end of the kiln, and at a point over the feed end the dust is carried by a screw conveyor that discharges into a small receiver resembling a cyclone dust collector in appearance. The incoming slurry is given a rotary motion which creates a vortex in the centre of the receiver. The dust falls into this vortex and the rotary motion mixes the dust with the slurry. No increase in the alkali content of the cement has been experienced as a result of feeding dust back to the kiln.

Chemical Analysis in the Cement Industry.*

Cement Raw Mixtures.

The sample to be analysed is ground to pass a No. 100 B.S. sieve and dried at 105 deg. C., and 2 gr. of the dried sample are accurately weighed into a weighed platinum crucible. The covered crucible is heated over a small flame at first and the temperature gradually raised during a period of fifteen minutes until it is at maximum temperature. The lid is then removed and the crucible transferred to a high-temperature muffle furnace where it is heated for twenty minutes at a temperature of 1350 to 1400 deg. C. The crucible is cooled in a desiccator and then weighed.

The loss in weight $\times 50$ is the percentage loss on ignition.

This loss on ignition requires correction for possible changes in sulphates, sulphides, chlorides, and alkalis in the process of ignition. These groups are determined on the original sample and the ignited sample by the methods described under "Argillaceous Materials."† In order to obtain sufficient ignited sample for all the corrections an additional 2 gr. should be ignited in another crucible under identical conditions.

Subsequent determinations of silica, alumina, ferric oxide, lime and magnesia are made according to the methods described under "Calcareous Materials."‡

Cement.

DETERMINATION OF SILICA.—The method described under "Argillaceous Materials"† may be followed, 1 gr. of the sample being placed in a porcelain basin and moistened with 10 cc. of cold water, 15 to 20 cc. of hydrochloric acid being added, and the contents of the basin digested with the aid of gentle heat, breaking down the material with the flattened end of a glass rod until it is evident that decomposition of the cement is complete. To the amount of silica obtained by the treatment with hydrofluoric acid must be added the amount of silica recovered from the R_2O_3 precipitate. In order to obtain this latter amount, the R_2O_3 precipitate, after the final weighing, is heated with six to seven times its weight of potassium bisulphate until the residue is dissolved in the melt. Cool, dissolve the fused mass in water containing 5 cc. of concentrated sulphuric acid, and evaporate the solution. Raise the temperature until copious fumes are evolved. Allow to cool, dissolve the mass in water, digest short of boiling for fifteen to thirty minutes, filter, and wash with water. Transfer the filter paper and contents to a platinum crucible. Dry and ignite the paper, first at a low heat until the paper is completely consumed without flaming and finally at 1100 to 1200 deg. C. until the weight remains constant. Treat the silica thus obtained in the crucible with a drop of water, about 5 cc. of hydrofluoric acid, and a drop of sulphuric acid, and evaporate to dryness. Finally heat the crucible at 1050 to 1100 deg. C. for one or two minutes, cool, and weigh. The difference between this weight and the weight previously obtained represents the amount of residual

* Continued from March and May, 1949. † In this journal for March and May, 1949.

‡ In this journal for May, 1949.

silica. This amount should be subtracted from the R_2O_3 previously determined and added to the silica obtained in the main determination.

It should be noted that with this method any insoluble residue it brought into solution and its components are incorporated in the main group analysis. The insoluble residue determined on a separate sample of the cement cannot be included in the main analysis and must be reported as a separate determination in a similar manner to the free calcium oxide.

Alternative Method.—One gramme of the cement is weighed into a 100-cc. beaker and about 1 gr. of ammonium chloride is added and thoroughly mixed with the cement by means of a small glass rod. The beaker is covered with a watch glass and 10 cc. of concentrated hydrochloric acid are very carefully added. After the initial reaction has subsided the contents of the beaker are thoroughly mixed and any remaining lumps broken up with the glass rod. The covered beaker is then heated on a hot plate or water bath, just short of boiling, for thirty minutes. The beaker is then removed from the hot plate or water bath, and the cover washed in, with as little water as possible, using a rubber-tipped glass rod to detach all adhering particles; 10 cc. of concentrated hydrochloric acid and sufficient water are added to bring the contents to about 40 cc. The mass is again well mixed and the beaker is heated just short of boiling for two minutes. It is then filtered on a 9-cm. No. 41 Whatman filter paper, the filtrate being caught in a 400-cc. conical beaker. The precipitate is transferred to the filter as completely as possible without dilution, and the solution allowed to drain through before washing out the beaker and cleaning the glass rods. The filter is then washed three times with hot 1 : 3 hydrochloric acid, or until the washing liquid in the filter appears to be colourless. The filter is then washed with hot water until it is free from chlorides, keeping the silica well stirred with each washing. The filter is then transferred to a weighed platinum crucible, dried, and ignited, at first slowly until the carbon of the paper is completely consumed without inflaming and finally at 1050 to 1100 deg. C. for thirty minutes. The crucible is then cooled and weighed.

The weight in grammes $\times 100$ is the percentage of silica plus insoluble residue.

The percentage of insoluble residue as described later is subtracted from this figure to give the percentage of silica.

DETERMINATION OF ALUMINA AND FERRIC OXIDE.—To the filtrate from the silica determination (together with any residue after the hydrofluoric acid treatment of the silica, in the case of the first method described), 5 cc. of bromine water are added and the solution brought to the boil. It is then treated with 1 : 1 ammonia solution, drop by drop, with constant stirring. Before precipitation is complete a few drops of methyl red indicator are added, and the addition of ammonia solution is continued until the solution becomes distinctly yellow. One drop of ammonia solution is then added in excess. The solution is brought to the boil for one minute and is then filtered through a 12.5 cm. No. 41 Whatman filter paper into an 800-cc. conical beaker. The original beaker is rinsed out several times with hot water, removing any precipitate adhering to the glass with

a rubber-tipped glass rod. The precipitate is washed on the filter with hot water, two or three drops of ammonium nitrate solution being added before each washing. The filter and precipitate are partially dried and ignited in a weighed platinum crucible.

The weight of ignited precipitate $\times 100$ is the percentage of R_2O_3 .

DETERMINATION OF FERRIC OXIDE.—One gramme of the cement is placed in a 400-cc. conical beaker, 40 cc. of cold water are added, and, while stirring vigorously, 10 cc. of concentrated hydrochloric acid are added. The solution is brought to the boil and boiled for two minutes. The solution is diluted with hot water to twice its volume and, while still boiling, stannous-chloride solution is added drop by drop until the solution is decolorised. One drop is added in excess, and the solution is then cooled to room temperature; 10 cc. of cool saturated mercuric-chloride solution are then added, the solution is stirred vigorously for one minute and allowed to stand for two to three minutes; 10 cc. of 1:1 phosphoric-acid solution and four drops of bariumdiphenylamine-sulphonate indicator are added, and the solution titrated with standard potassium-dichromate solution (1 cc. = 0.005 gr. Fe_2O_3).

The number of cubic centimetres of standard dichromate solution required $\div 2$ equals the percentage of Fe_2O_3 .

DETERMINATION OF LIME.—To the filtrate from the R_2O_3 , 10 cc. of concentrated ammonia solution are added. The solution is brought to the boil, 70 cc. of boiling ammonium-oxalate solution (50 gr. per litre) are added, and boiling is continued until the precipitated calcium oxalate assumes a well-defined granular form. It is allowed to stand for four hours in a warm place and then filtered on a double 11-cm. No. 40 Whatman filter paper. The precipitate on the filter is washed moderately with hot 1 per cent. ammonium-oxalate solution. The filter and contents are transferred to a weighed platinum crucible, the paper is smoked off, and then ignited until the paper is completely consumed. The crucible is allowed to cool, and concentrated sulphuric acid is added drop by drop until the precipitate is thoroughly moistened. The excess of acid is evaporated in a fume cupboard over a low flame. When fumes cease to be evolved the crucible is covered and brought to a dull red heat. After heating for two to three minutes the crucible is cooled and weighed.

The weight of calcium sulphate $\times 41.20$ is the percentage of CaO .

DETERMINATION OF LIME (RAPID VOLUMETRIC METHOD).—Half a gramme of the cement is weighed into a 500-cc. beaker and 20 cc. of cold water are added with constant stirring. The lumps are broken up, and when all the sample is in suspension 20 cc. of concentrated hydrochloric acid are added and the mixture heated until solution is complete. The solution is brought to the boil and dilute ammonia solution added carefully until a slight permanent precipitate is formed. The solution is again brought to the boil and 10 cc. of a 10-per cent. solution of oxalic acid added and stirred until the precipitate of ferric and aluminium hydroxides is completely dissolved and only a slight precipitate of calcium oxalate remains. The solution is diluted to about 300 cc. with boiling water and

50 cc. of boiling ammonium-oxalate solution (50 gr. per litre) are added. Boiling is continued until the precipitated calcium oxalate assumes a well-defined granular form. The beaker is then removed from the hot plate. The precipitate is allowed to settle and is filtered through a No. 40 Whatman filter paper. The precipitate in the beaker is washed three times by decantation, transferred to the filter and washed ten times with hot water. The filter paper is then removed from the filter funnel and the precipitate washed back into the original beaker; 200 cc. of water and 10 cc. of 1:1 sulphuric acid are added, and the solution heated just short of boiling. It is then titrated with standard potassium permanganate solution (1 cc. = 0.005 gr. CaO) to a permanent pink colour. The filter paper is then added and macerated. Titration is continued slowly until the pink coloration is permanent for ten seconds.

The number of cubic centimetres of standard permanganate solution \div 2 equals the percentage of CaO.

DETERMINATION OF MAGNESIA.—The filtrate and washings from the precipitation of calcium oxalate are treated as described under "Argillaceous materials."*

DETERMINATION OF INSOLUBLE RESIDUE.—One gramme of cement is weighed into a 250-cc. beaker and stirred with 40 cc. of water; 10 cc. of concentrated hydrochloric acid are then added and the mixture stirred again. The mixture is then warmed, any lumps being broken up, and boiled for ten minutes, maintaining constant volume and stirring if necessary. The contents of the beaker are then filtered, the beaker rinsed out five times with hot water, and the residue on the filter washed about ten times with hot water. The residue is then washed from the filter paper back into the original beaker with about 30 cc. of hot water and boiled for ten minutes with 30 cc. of 2N sodium-carbonate solution (106 gr. per litre), maintaining constant volume. The contents of the beaker are then filtered again through the same filter paper and washed at least five times with water, taking care to transfer all the residue to the paper, then with a little 2N hydrochloric acid solution, and finally with water until the contents are free from chlorides. The filter paper with the residue is then dried, ignited, and weighed.

This weight \times 100 is the percentage of insoluble residue.

DETERMINATION OF SULPHATE.—The acid filtrate from the insoluble residue is treated as described under "Argillaceous Materials."†

DETERMINATION OF SULPHIDE.—The procedure, using 1 gr. sample of cement, is as described under "Argillaceous Materials."†

DETERMINATION OF LOSS ON IGNITION.—One gramme of cement is weighed into a platinum capsule and ignited for twenty minutes in a muffle furnace at 900 to 1000 deg. C. It is then cooled and weighed again.

DETERMINATION OF FREE LIME.—Of the sample, 0.75 gr., ground to pass a B.S. sieve No. 170, is weighed into a clean and dry 200-cc. Taylor flask, together with about 5 gr. of standard sand (previously treated with hydrochloric acid, washed thoroughly, and dried) and 40 cc. of ethylene glycol. The flask is closed

* In this journal March, 1949. † In this journal May, 1949.

by a rubber bung and its contents thoroughly mixed. It is then immersed in a water bath maintained at a temperature of 65 to 70 deg. C. for thirty minutes. Every five to eight minutes the contents of the flask are shaken. The solution is then filtered through a No. 1 G3 sintered glass filter with the aid of suction. Except when the liquid is poured on to the filter, the latter is kept closed by a rubber bung fitted with a glass U-tube containing fresh soda-lime. When all the liquid has been transferred to the filter the flask is washed three times with 10 cc. of absolute alcohol, the washings being poured on to the filter each time. The clear filtrate is then titrated with N/10 hydrochloric acid using methyl-orange indicator (0.1 gr. of methyl orange in 100 cc. of absolute alcohol). The end point is reached when the colour changes from a bright straw yellow to an orange pink. A blank determination should always be made on a fresh stock of ethylene glycol and the necessary corrections made.

The number of cubic centimetres of N/10 HCl (after correction for blank test on glycol) \times 0.373 equals the percentage of free CaO.

Alternative Method.—One gramme of the sample is weighed into a clean and dry 200 cc. Erlenmeyer flask and 60 cc. of glycerol-ethyl-alcohol solvent are added. The solvent consists of 1 part by volume of glycerol and 5 parts by volume of ethyl alcohol. To each litre of this mixture 20 cc. of phenolphthalein indicator (1 gr. phenolphthalein in 100 cc. of ethyl alcohol) and 17 gr. of anhydrous barium chloride are added. The solvent should be slightly alkaline to the indicator when cold, but on boiling the pink colour should disappear. If the solvent is acid a dilute solution of sodium hydroxide in ethyl alcohol is added until a slight pink colour appears. If the solvent is strongly alkaline, the pink colour is removed by the addition of standard ammonium acetate solution and alcoholic caustic soda added until a slight pink hue appears.

The sample is dispersed in the solution by shaking the flask, adding if necessary a few grammes of clean and dry quartz sand. The flask is then attached to a reflux condenser and the mixture brought to the boil on a water bath and boiled for twenty minutes. The condenser is then removed and the solution titrated, while near boiling, with standard ammonium acetate solution (1 cc. = 0.005 gr. CaO). The condenser is then replaced and the solution boiled again for a further twenty minutes. The titrations are repeated at intervals until the content of free lime does not increase by more than 0.05 per cent. between successive titrations. The flask should be shaken frequently between titrations to hasten the solution of the free lime.

The solution of ammonium acetate is prepared by dissolving 16 gr. of crystalline ammonium acetate in 1 litre of ethyl alcohol and is standardised by titrating against pure CaO freshly prepared by calcining pure calcium carbonate in a platinum crucible at 900 to 1000 deg. C. to constant weight. The standardisation is performed in the same manner as described for the determination of the free lime in cement. If the ammonium acetate solution is not standard, the necessary adjustment is made to the amount of alcohol until 1 cc. = 0.005 gr. CaO.

(To be concluded).

The Cement Industry in Britain.

As is usual the annual statement of the chairman to the stockholders of the Associated Portland Cement Manufacturers, Ltd., gave this year a general indication of the affairs of the British cement industry. The following notes are from the statement of the chairman accompanying the accounts of the Company for the year 1948.

The Cost of Depreciation.

It was customary to provide for the depreciation of fixed assets on the basis of historical cost, but it was essential to set aside the maximum reserves possible against the increased cost of replacing productive capacity at current inflated prices. Their own Company had a productive capacity of about 2,750,000 tons per annum before 1939. The cost of this capacity at approximately 50s. per ton would have been about £7,000,000, whereas at to-day's prices the cost of replacement alone would be about £19,000,000. Profits would be unreal if, under present conditions, large reserves were not set aside year by year for this purpose, but unfortunately the present basis and scale of taxation restricted the amounts which could be allocated to such reserves. The Company's Depreciation and Depletion Reserves at 31 December, 1947, amounting to £925,000 had been transferred to a Plant and Machinery Replacement Reserve and this year a further £425,000 had been set aside for this purpose. Expenditure on the conversion of coal-burning plants to oil burning, which was undertaken at the Government's request, had to be abandoned and the expenditure under this heading, amounting to £103,385, had been written off. The net fixed assets of the group, excluding capital works in progress, amounted after depreciation to £8,016,967. These included, in addition to cement-making plants, other assets of great value such as tugs, barges, motor lorries, paper-bag and drum-making plants, and plant used for the manufacture of lime, whiting, bricks, and other commodities. The cement-making plant had a capacity of about 6,600,000 tons per annum and the present cost of replacing it would be about £47,500,000. The sum of £21,196,708 had been written off as depreciation and the reserve for replacement of plant and machinery amounted to £2,825,833; these two sums represented 51 per cent. of the present estimated cost of replacement of the Company's cement works.

Exports.

Compared with the previous year the trading profit increased by £1,107,771. The proportion of the gross profit derived from the home trade was less than 20 per cent. The export sales were a record in the history of the Company, as was the total production. Foreign investments and materials other than cement provided one-third of the total gross profit.

Capital Expenditure.

On December 31, 1948, votes sanctioned for new works and extensions and improvements to existing works in the group at home and abroad amounted to £10,586,000, and other projects under consideration would, if sanctioned, add

about £1,800,000 to this sum. Actual expenditure and definite commitments now amounted to over £6,500,000. The actual spending of the money must necessarily be spread over a period of years. The building of new works in these days of high cost and constant delays was a matter which gave much anxiety. The group, as the largest cement-making organisation in England, and indeed in the world if their foreign interests were taken into account, had a duty to do its full share in keeping the home and export markets adequately supplied. Except for this duty the building of new works was not attractive at present. As an example their new works at Shoreham, which should produce 350,000 tons of cement a year, would cost nearly £2,500,000, or about £7 a ton. Depreciation and interest on the money and amortisation would be 10 per cent., or 14s. a ton. Before the war a similar works on this site could have been built for about 50s. a ton, and the charge for depreciation, etc., would have been 5s. a ton. The cement industry had been working on a home trade profit of under 6s. per ton. It was therefore obvious that with existing selling prices a new works could not be profitable, although fortunately in this case the increased production would reduce the general overhead costs and costs of delivery and the new works should produce cement very cheaply. Because it seemed probable that before long the cost of construction would be lower, the Company was at present as far as possible planning to obtain increased output in this country from extensions of existing works rather than from new ones. The improvements and extensions which were now completed or in hand, since 1 January, 1948, should by the end of this year be giving an additional productive capacity of over a quarter of a million tons. The work of the research department had helped considerably in the cost of production, and the development of new products, and in improving still further the quality of their products. Unfortunately, an application for a licence to build a new research laboratory had been deferred by the Ministry.

Oversea Interests.

Although operating conditions in all countries where the Company had interests overseas were generally favourable, a serious setback occurred in Mexico in July, 1948, when the Mexican treasury ceased to quote an official rate for the peso against sterling, and it was allowed to find its own level. This resulted in a depreciation in the value of the peso in terms of sterling of some 40 per cent. The sterling value of dividends received from Mexico had been and would be reduced. Depreciation of the currency was only one effect of the continued depressed state of business in Mexico. So far as their associated companies were concerned, deliveries were only slightly lower but for the first time in many years output was meeting demand. The new works at Tolteca was now complete and in the initial stages of operation.

In South Africa the local industry was still unable to meet the demand and a considerable quantity of cement was imported. As there were no water shortages, output and deliveries by their subsidiary company approached past records. Costs, prices and profits remained roughly the same. It was not expected that the first kiln at Lichtenburg would start before September this year, as the usual

delays had been encountered. During the next twelve months much additional capacity would be coming into operation in South Africa and for the first time in several years the Union's potential output would exceed foreseeable demand. It was unfortunate that this situation might be aggravated by some recession of industrial activity in the Union.

Notwithstanding a coal strike which lasted several months the British Columbia company last year improved even upon its record year 1946-47. They had continued the technical investigations into a proposed new works, but no decision had yet been reached. After long and very careful consideration it was decided that in present circumstances the Company was no longer interested in establishing a cement works in Trinidad. Technical surveys still continued in Malaya, despite the disturbed conditions of the country and the uncertain outlook in South East Asia.

Negotiations which started in 1948 for the acquisition of the major part of the capital of the Commonwealth Portland Cement Company had been successfully concluded. This was an old-established business, which had a production capacity of about 200,000 tons a year. The works were in need of modernisation, but fortunately the Commonwealth Company has considerable liquid assets which should be sufficient to finance the greater part of this work. It was believed that this investment would prove to be satisfactory, and would enable them to help and share in the undoubted development which would take place in Australia.

Nationalisation.

The Labour Party's draft programme said that if they were again in power after the next general election the cement industry would be nationalised. The business reasons for this proposal were not apparent. The Government had strictly controlled the home trade selling price for the past ten years, and had praised the industry for the way in which it had been managed. When one compared the amount provided for taxation with the net amount paid to the Preference and Ordinary stockholders, it was seen that the Government now received 72 per cent. of the total. It could, therefore, be said that their companies were now working for the stockholders for $3\frac{1}{2}$ months each year and for the country the rest of the time. The profits kept in the business should be the same, whether it was nationalised or not. On the question of the efficiency of the industry, their production per man was as high as in the U.S.A., the price of cement had advanced only about half as much as that of general building materials since 1939, and the price of cement in London was now lower than in the capital of any country in the world which was producing its own cement. There had been considerable publicity about the cost of overheads in nationalised industries. It was, therefore, of especial interest to report that their selling and administrative expenses as a percentage of the cost of manufacture of Portland cement before charging depreciation showed a reduction of over 28 per cent. compared with before the war. In view of these facts, and that the Government received their share of the profits without taking any responsibility except that of collecting the tax, it made one feel that they would be taking a grave risk to achieve very little, and reminded

one of Aesop's fable of "The Goose that laid the Golden Egg." It would seem that the proposal was based on political motives. A public company owed allegiance to no political party and they did not know the political views of the stockholders, but they did know their views on the nationalising of their industry and that they desired the directors to do all they could to oppose compulsory purchase by the Government.

Current Prospects.

This year had started well. Their production and deliveries were higher than ever before, and their export trade was breaking all records. It was not to be expected that sales abroad would continue indefinitely on this scale. New productive capacity was being built in markets which they supplied, but their export trade should be good this year, and with the home trade should keep all their works at full output. He felt confident that they would have a satisfactory report when they met next year.

Concrete Chimneys at Indian Cement Works.

A STANDARD design of reinforced concrete chimney is adopted at the cement works of the Associated Cement Companies, Ltd., in India. According to a report in the "Indian Concrete Journal" three of these chimneys have been erected. Each chimney is 175 ft. high and has a uniform external diameter of 13 ft. 1 in. The wall has a constant thickness of 8 in. and the shaft is lined throughout, the least internal diameter (to the face of the corbels) being 9 ft. 6 in. Standardised continuously-sliding shuttering is used for the construction of the chimneys.

Hardfacing by Welding.

A WELL-ILLUSTRATED account of the processes used in the repair and strengthening of metal by welding a wear-resisting alloy on to the surface subjected to wear is contained in "Hardfacing by Welding," by M. Riddihough (London: Iliffe & Son, Ltd. Price 8s. 6d.). The treatment of the air-injector ring of a cement pump, cement conveyor screws, and other machinery used in cement manufacture are described.

New Cement Works in Sweden.

THE first rotary kiln installed at the new cement works at Storavika of the Skanska Cement Company is now in operation. The works will eventually have two kilns, with a total capacity of 350,000 tons a year.

Patents Relating to Cement Manufacture.

During the war the publication of abridged British patent specifications was stopped, with the result that those now being published relate to patents granted some years ago. The following patents relating to cement manufacture are among those recently published.

Production of Cement and Iron.

Fig. 1.—Cement and/or hydraulic lime produced in a rotary kiln simultaneously with the production of iron or with the refining of iron or other metal, is subjected to air to oxidize wholly or partially any ferrous oxide, sulphite, or free carbon. The cement clinker may be cooled and crushed and the iron separated magnetically prior to oxidation, which may be effected

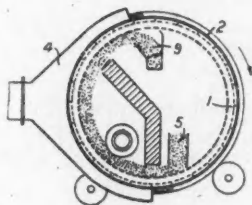


Fig. 1.

in a rotary kiln in which cement is being burnt. The clinker, converted into a porous mass, is supplied to a hopper (5) within a perforated rotary grate (1) in a perforated drum (2), and is removed through a hopper (9) after air has been passed therethrough and withdrawn through a hood (4).—No. 579,762. M. Vogel Jørgensen. June 10, 1941.

Composition of Cement.

A cement consisting of grains of different sizes in substantially the proportions present in ordinary cement has the larger grains, of from 30 to 200 microns, of inert material such as flint, basalt, limestone, or mixtures thereof, while the smaller grains consist of

finely-ground cement clinker. The inert material may constitute 16 to 50 per cent. by weight of the cement, and is preferably broken, dried, and ground before mixing with the ground calcined cement clinker, mixing being effected by a screw conveyer, mixing-drum, or other apparatus. According to the examples, the inert material is composed of equal parts of flint and limestone.—No. 580,291. S. Gottlieb and Portland Cement Co. Nesher, Ltd. June 26, 1944.

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